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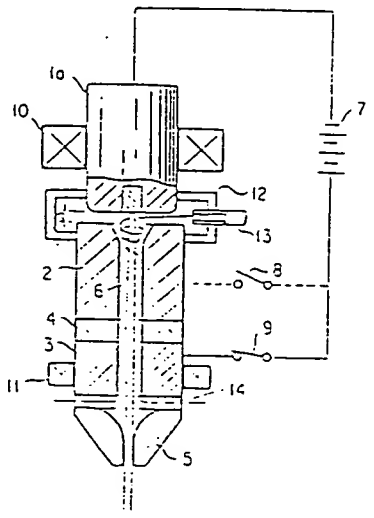
(54) ELECTRODE STRUCTURE OF A NON-TRANSFER-TYPE PLASMA TORCH.

(57) An electrode structure of a non-transfer-type plasma torch which exhibits small-current and high tension operation characteristics, which heightens the plasma jet energy efficiency, which lengthens the electrode life, and which produces a stable plasma arc column. The electrode structure is provided with an intermediate electrode (2) which is interposed between a cathode (1) and an anode (3) maintaining electric insulation to generate pilot arc by r.f. discharge relative to the cathode (1), and an operation gas branch hole (14) provided between the anode (3) and the plasma jet nozzle (5) so that a discharge space (6) may communicate with the exterior of the torch. This enables the distance of a discharge space to be lengthened between the cathode (1) and the anode (3) and the flow rate of the operation gas to be controlled. Further, the anode (3) is electrically insulated from the nozzle (5).

FIG. 1



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trical discharge is allowed through the clearance.

As described above, in the conventional type of the plasma torch, the clearance between the rod-shaped cathode and the nozzle constituting the anode is relatively small. Consequently, the voltage of the main arc discharge is also small and substantially within a range of from 20 to 40 V. However, in order to increase an output of a plasma jet issued from the nozzle, it is necessary to increase the current of the electrical discharge. As the current of the electrical discharge increases, an amount of the Joule heat produced in both of the rod-shaped cathode and the nozzle constituting the anode rapidly increases to considerably reduce their lives, particularly, the nozzle's life because discharged electrons hit the nozzle constituting the anode.

In addition, in the conventional plasma torch, since the amount of the Joule heat produced in both of the rod-shaped cathode and the nozzle constituting the anode is extremely large, a large amount of an input energy is removed by a cooling water and constitutes a considerable energy loss, so that the plasma jet produced in the conventional plasma torch is considerably poor in energy-saving efficiency.

Furthermore, in the conventional plasma torch, the arc produced on the nozzle constituting the anode

to the present invention, there is provided an electrode structure of a non-transfer-type plasma torch comprising a holder for holding a cathode at its center-line position, and a plasma-jet nozzle which is so fixedly mounted on said holder that said nozzle holds an anode at a position spaced apart from said cathode, said anode being symmetrical with respect to its own longitudinal axis, characterized in that said cathode has a small-diameter cylindrical shape and is held at a front-end portion of said holder so as to be symmetrical with respect to a longitudinal axis of said holder, and in that said electrode structure further comprises: an intermediate electrode, which is symmetrical with respect to its longitudinal axis and interposed between said cathode and said anode so that said intermediate electrode is spaced apart from said cathode; an electrical insulator interposed between said intermediate electrode and said anode so as to insulate said intermediate electrode from said anode; a branched hole for a working gas, which hole is defined between said anode and said nozzle to establish communication between an electrical-discharge space and an exterior space, said electrical-discharge space being adjacent to a longitudinal axis of said plasma torch; and an electrical circuit provided with a switch interposed between

it possible to prevent the flow rate of the working gas passing through the electrical discharge space from being considerably reduced.

Other objects and advantages of the present invention will be apparent from the following description of the preferred embodiment of the present invention considered in connection with the accompanying drawings, submitted for purposes of illustration only and not intended to limit the scope of the present invention, reference being had for that purpose to the subjoined claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a longitudinal sectional view of an essential part of an embodiment of the electrode structure of the non-transfer-type plasma torch of the present invention;

Fig. 2 is a partially broken side view of the electrode structure of the plasma torch of the present invention for fine-cutting use; and

Fig. 3 is a partially broken side view of another embodiment of the cathode employed in the electrode structure of the plasma torch of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention will be hereinbelow described in detail with reference to the drawings, particularly in Fig. 1 wherein: the reference

like while coaxially mounted on an outer peripheral portion of the holder 1a holding the cathode 1. On the other hand, an anode-control magnet 11 is constructed of an electromagnetic coil, a permanent magnet or the like while coaxially mounted on an outer peripheral portion of the anode 3.

As shown in Fig. 1, the interior space of a cylindrical chamber 12 for receiving a working gas or plasma-forming gas is defined between a front-end portion of the cathode 1 encircled with its holder 1a and the intermediate electrode 2. The chamber 12 is provided with a plurality of working-gas inlet nozzles 13 in its peripheral portion, which nozzles 13 so open into the chamber 12 as to produce a swirl of the working gas in the chamber 12. A working-gas branched hole 14 is provided in the plasma torch at a position between the anode 3 and the plasma-jet nozzle 5 so as to open into an exterior space. Both of the plasma-jet nozzle 5 and the working-gas branched hole 14 can be varied in their opening area for accomplishing the purposes of individual applications.

In operation of the plasma torch of the present invention having the above construction, the switch 8 interposed between the intermediate electrode 2 and the electrical power source 7 is first turned on to produce a high-frequency electrical discharge constituting a

plasma torch 5 of the present invention, there is no fear that the flow rate of the working gas passing through the electrical discharge space in the anode 3 drastically decreases, because the working-gas branched hole 14 enables the flow rate of the working gas passing through the branched hole 14 to increase when the opening area of the plasma-jet nozzle 5 is reduced.

On the other hand, the electric arc or plasma produced on the cathode 1 of the plasma torch of the present invention is controlled by the cathode-control magnet 10 coaxially mounted on the outer peripheral portion of the cathode holder 1a so as to have a long life.

In addition, the anode-control magnet 11 coaxially mounted on the anode 11 causes the electric arc produced on the inner wall surface of the anode 3 to circumferentially rotate therealong, so that the anode 3 has a considerably long life and makes the output of the plasma torch of the present invention considerably stable.

In this connection, in the plasma torch of the present invention, since the anode 3 is electrically insulated from the plasma-jet nozzle 5, there is no fear that the nozzle 5 is rapidly eroded and deformed under the influence of the Joule heat, whereby it is possible to ensure formation of a long-life stable high-energy

What is claimed is:

1. In an electrode structure of a non-transfer-type plasma torch comprising: a holder for holding a cathode at its center-line position; and a plasma-jet nozzle which is so fixedly mounted on said holder that said nozzle holds an anode at a position spaced apart from said cathode, said anode being symmetrical with respect to its own longitudinal axis; the improvement characterized in that said cathode has a small-diameter cylindrical shape and is held at a front-end portion of said holder so as to be symmetrical with respect to a longitudinal axis of said holder, and in that said electrode structure further comprises: an intermediate electrode, which is symmetrical with respect to its longitudinal axis and interposed between said cathode and said anode so that said intermediate electrode is spaced apart from said cathode; an electrical insulator interposed between said intermediate electrode and said anode so as to insulate said intermediate electrode from said anode; a branched hole for a working gas, which hole is defined between said anode and said nozzle to establish communication between an electrical-discharge space and an exterior space, said electrical-discharge space being adjacent to a longitudinal axis of said plasma torch; and

FIG. 1

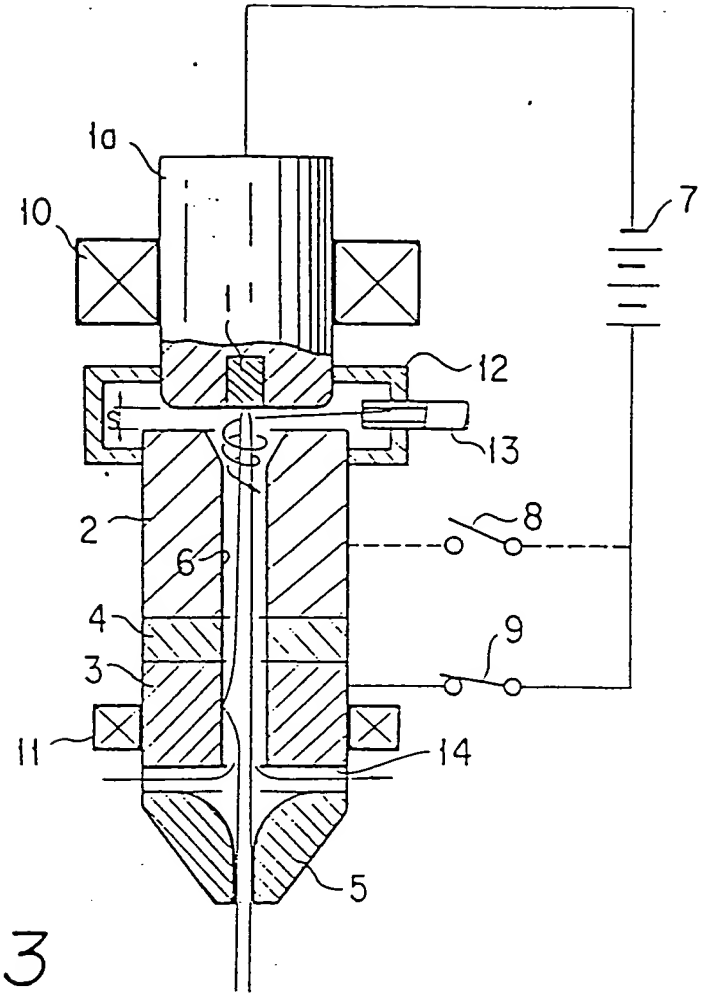

FIG. 3